BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 255 853**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 87105883.0

(51) Int. Cl.4: B25B 5/12 , B23Q 3/06

(22) Date of filing: 22.04.87

(30) Priority: 08.08.86 US 894963

(43) Date of publication of application:
17.02.88 Bulletin 88/07

(84) Designated Contracting States:
BE DE ES FR GB IT NL SE

(71) Applicant: Dover Corporation, De-Sta-Co Division
250 Park Street
Troy, MI 48007(US)

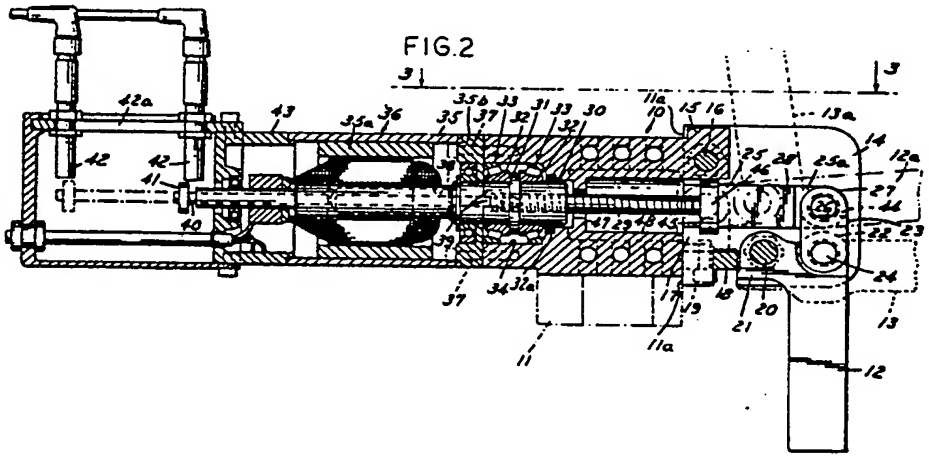
(72) Inventor: McPherson, Alexander
29676 Middlebelt Road
Farmington Hills, MI 48018(US)
Inventor: Harkrader, Alan
6333 Hayes Tower Road
Gaylord, MI 49735(US)

(74) Representative: Wehnert, Werner et al
Patentanwälte Dipl.-Ing. Hauck, Dipl.-Phys. Schmitz, Dipl.-Ing. Graalfs, Dipl.-Ing. Wehnert, Dipl.-Phys. Carstens, Dr.-Ing. Döring Mozartstrasse 23
D-8000 München 2(DE)

(54) Rotary powered linear actuated clamp.

(57) Rotary powered linear actuated clamp having hollow electric motor drive shaft coupled to threaded nut axially retained by reaction roller thrust bearings driving a linear threaded rod having integral toggle linkage actuator guided by anti-friction rollers in linear lateral reaction tracks.

FIG.2



EP 0 255 853 A2

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 255 853 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication of patent specification: **03.03.93** (51) Int. Cl.5: **B25B 5/12**, B23Q 3/06

(21) Application number: **87105883.0**

(22) Date of filing: **22.04.87**

(54) Rotary powered linear actuated clamp.

(30) Priority: **08.08.86 US 894963**

(43) Date of publication of application:
17.02.88 Bulletin 88/07

(45) Publication of the grant of the patent:
03.03.93 Bulletin 93/09

(84) Designated Contracting States:
BE DE ES FR GB IT NL SE

(56) References cited:
EP-A- 0 243 599
DE-C- 3 638 526
US-A- 1 404 862
US-A- 4 458 889
DD-A- 138 643
GB-A- 2 068 272
US-A- 2 956 188

K. SCHREYER: "Werkstückspanner (Vorrichtungen)", 3rd edition,21969, pages 80-81, Springer-Verlag, Berlin, Heidelberg, DE

(73) Proprietor: **Dover Corporation, De-Sta-Co Division**
250 Park Street
Troy, MI 48007(US)

(72) Inventor: **McPherson, Alexander**
29676 Middlebelt Road
Farmington Hills, MI 48018(US)
Inventor: **Harkrader, Alan**
6333 Hayes Tower Road
Gaylord, MI 49735(US)

(74) Representative: **Wehnert, Werner et al**
Patentanwälte Dipl.-Ing. Hauck, Dipl.-Phys. Schmitz, Dipl.-Ing. Graalfs, Dipl.-Ing. Wehnert, Dipl.-Phys. Carstens, Dr.-Ing. Döring
Mozartstrasse 23
W-8000 München 2 (DE)

EP 0 255 853 B1

Description

The present invention relates a clamp device as defined in the preamble of claim 1; see DD-A-138 643

Conventional power actuated industrial clamps typically employ air or hydraulic linear pistons to actuate clamp arms through toggle linkage, a recent version of which is disclosed in U. S. Patent No. 4,458,889 issued on July 10, 1984. Such clamps, as used in industrial production for repetitively holding identical work pieces during processing operations, are generally limited to a single dedicated clamping position with toggle linkage near or preferably at centered position, at which the clamp will remain locked upon release of actuating pressure and at which maximum clamping force may be exerted for a given actuating pressure. Any clamp setting appreciably short of centered toggle linkage necessitates retention of actuating pressure for the duration of clamping requirement.

In order to provide alternative electrically powered clamps, various electric motor drives have been adapted to provide clamping action, as in actuating a work clamp through worm gearing, such as disclosed in U. S. Patent No. 2,395,242 or in actuating a tubular piston through a lead screw driven by an offset electric motor such as disclosed in U. S. Patent No. 4,137,784.

Without application to the clamping art, certain electric motor actuated jacks or other screw actuated devices are disclosed in U. S. Patents Nos. 733,614, 1,279,346, 1,404,862, 1,543,181, and 2,956,188, each of which has the common feature of a feed screw extending through and in axial alignment with the electric motor.

In the last of such patents, employed for valve operation, a control indicator rod extends from the tail end of the feed screw out of the motor housing in a manner having some similarity to a control feature employed in the present invention.

With regard to requirements of industrial clamps, it is a generally recognized desirable feature for the clamp to be self-locking in its clamping position to avoid the requirement for maintaining power-on actuation.

With regard to the above, a clamp device according to the invention is defined in claim 1.

Applicants have combined the self-locking characteristics of a non-rotating, linearly displaced threaded axial rod directly driven by rotation of an axially retained nut coupled to a hollow motor shaft for actuating toggle linkage such as disclosed in said Patent No. 4,458,889. The nut is tang driven directly by the motor shaft, axially retained by roller thrust bearings, and provided with a molded "Moglice" moly-disulphide thread for driving the linear threaded rod which has an integral link actuator guided by anti-friction rollers in a linear track for actuating the toggle linkage. The threaded actuating rod has a reduced diameter control rod projecting through the back end of the motor shaft and motor housing on which an adjustable switch trip is secured for controlling the power-on stroke of the actuator.

Maximum clamping pressure is obtained at the centered position of the toggle linkage; however, clamping at any position of the clamp arm from fully retracted to centered maximum clamping force position may be provided subject to intermediate clamping force limits progressively increasing as the toggle linkage approaches centered position. At any clamping position there is no need for retaining actuating power during clamp retention of the work piece due to the self-locking characteristic of the nut screw actuation.

Various forms of clamping mechanism in addition to toggle linkage may be employed subject to a linear actuating connection to the threaded rod link actuator.

Fig. 1 is a front elevation of the preferred embodiment;

Fig. 2 is sectional side elevation taken along the line 2-2 of Fig. 1;

Fig. 3 is a plan view taken along the line 3-3 of Fig. 2;

Fig. 4 is an enlarged view of the clamp body per se shown in the assembly of Fig. 2;

Fig. 5 is a fragmentary plan view taken along the line 5-5 of Fig. 4;

Fig 6 is an enlarged view of the roller track plate per se illustrated in the assembly views of Figs. 1, 2, and 3;

Fig. 7 is an enlarged end view of the drive nut shown in the sectional side elevation of Fig. 2;

Fig. 8 is a sectional view taken along the line 8-8 of Fig. 7;

Fig. 9 is an enlarged side elevation of the motor drive shaft shown in Fig. 2;

Fig. 10 is an end view of the drive shaft shown in Fig. 9;

Fig. 11 is an enlarged side elevation of the threaded link actuator shown in Fig. 2;

Fig. 12 is an end view of the link actuator shown in Fig. 11;

Fig. 13 is an enlarged fragmentary sectional view of the thread form employed in the threaded link actuator of Fig. 11;

Fig. 14 is an enlarged plan view of the key stop per se illustrated in the assembly views of Figs. 1, 2, and 3;

With reference to Figs. 1, 2, and 3, clamp body 10 is adapted for attachment to a fixed base 11 located against registration surface 11a of side plates 14 on which a work piece fixture, may be

recess 69 accommodates retraction of threaded end 29 of link actuator 25 and lead to through passage 70 for rod 40 threaded into tapped hole 71 in threaded end 29 with retention provision 72 for set screw or cross pin. Annular shoulder 46 as well as link actuator diameter 73, although greater than the thickness of arm 12 and spacing of roller track plates 14 shown in Fig. 1, have clearance resulting from track 28 recesses so that no interference results from extension of shoulder 46 between plates 14 as shown in Fig. 2.

With further reference to Figs. 7 and 8, drive nut 30 is provided with a suitable low friction thread material such as bronze, plastic, ball nut or a molded moly-disulphide threaded liner 74 retained in nut housing 75 by cross thread grooves 76, or by base thread form in nut housing 75, and has a special thread form 77, as shown in the greatly enlarged fragmentary view of Fig. 13, molded in place on a master screw. The preferred plastic material is available under the trade name "Moglice" and registered trademark "Diamant" distributed by Moglice Products Inc., as supplied by the German company Diamant Metallplastic GMBH. Such material is characterized by low friction, high strength, durability against wear, and minimal shrinkage in the molding process to assure a substantially perfect fit with full thread engagement and virtually zero backlash in operation.

DESCRIPTION OF MODIFIED EMBODIMENT

With reference to Fig. 15, a toggle clamp mechanism 100 similar to that shown in Fig. 2 is actuated by a reciprocable non-rotating nut 101 connected to adapter link actuator 102 which is motor driven by screw 103 axially retained within thrust bearings 104, with an auxilliary reduction gear drive through gear box 105 provided from electric motor 106. A similar Moglice molded nut thread 107 provides similar drive characteristics with a reversal of the rotating and reciprocating elements.

An adjustment provision for limiting end travel of each roller 108 through pad 109 positioned by adjustment screw 110 having stop nut 111 located in mount bracket 112 attached by suitable means to side plate 113.

An optional lateral reaction provision is illustrated by phantom anti-friction roller 114 mounted on bolt 115 extending through side plates 113 to take the place of track and roller bearings 108.

ADDITIONAL MODIFIED EMBODIMENT

With reference to Fig. 16, a drive unit similar to that illustrated in Fig. 15, is adapted to actuate modified clamp arm 200 pivotally connected at 201 to side plates 202, having slide guide tracks 203 with a "Geneva" type engagement of arm slot 204 by roller 205 suitably driven by drive nut extension 206.

From the foregoing description, it will be understood that any of the modifications may be mounted for clamping position of the arm at any intermediate location of the linkage travel, subject to resultant limitations in mechanical advantage of the linkage with regard to available clamping force, but with assured power-off locking at any position due to the irreversible drive characteristics of the threaded screw actuation and appropriate thrust bearings to absorb clamping pressure reaction. It is also clear that various forms of clamping linkage can be actuated by linear displacement produced by motor drive shaft rotation of a threaded element, axially retained by thrust bearings, engaging a threaded linear element confined against rotation and lateral clamping reaction thrust by linear guide tracks, preferably engaged by anti-friction roller bearings on said linear element.

Claims

1. Rotary/linear clamp linkage actuator comprising base, reversible motor, drive shaft, threaded nut, threaded rod, linkage, lateral reaction and clamp elements characterized by a rotary and linear drive displacement connection between said nut and rod actuated by axially aligned motor drive shaft and axial thrust retention means for one and axial displacement drive means for the other of said nut and rod elements, said other element having a non-rotational axial drive connection with said linkage and linear guide connection with said lateral reaction element, said linkage having an actuating connection with said clamp.

2. Actuator of Claim 1 including a rotary drive connection from said drive shaft to said threaded nut.

3. Actuator of Claim 2 including anti-friction thrust bearing means for effecting axial retention of said threaded nut.

4. Actuator of Claim 2 including a molded plastic nut thread.

5. Actuator of Claim 4 wherein said plastic thread comprises moly-disulphide.

6. Actuator of Claim 5 including a plastic thread form having an arcuate root.

7. Actuator of Claim 6 wherein said arcuate root extends tangent to angular side flanks.

13. Spannvorrichtung nach einem der vorhergehenden Ansprüche, bei der die Motorwelle als durchmesserabgestufte Welle mit einem keilverzahnten Äußeren (66), einem als Gegenbohrung ausgebildeten Inneren (69), einem Steuerstangenkanal (70) und einem Mitnehmerende (69) ausgebildet ist.

14. Spannvorrichtung nach Anspruch 12 oder 13, bei der die Gewindespindel eine integrale Gestängebetätigungsverlängerung (25a) und ein mit einer Öffnung versehenes Ende aufweist, das einen Querstift (26) zur Lagerung der in den Schienen laufenden Rollen (21) aufnehmen kann.

15. Spannvorrichtung nach Anspruch 10, bei der die Basis eine einteilige Verlängerung zwischen den beiden Schienenelementen zur Verbindung mit diesen und zwei äußere Seitenverlängerungen (19) seitlich außerhalb der Schienenelemente aufweist.

16. Spannvorrichtung nach Anspruch 15, mit einem an den Seitenverlängerungen anbringbaren Anschlagelement (18) mit Abstandsmitteln, die die Schienenelemente sowohl in Vorwärts- und Rückwärtsrichtung wie auch in seitlicher Richtung beabstanden, um einen Freiraum für die Spannarm-Schwenklagerung dazwischen zu bilden.

17. Spannvorrichtung nach einem der vorhergehenden Ansprüche, bei der das seitliche Führungselement Wälzlagermittel aufweist, die an der an dem anderen Element angreifenden Basis befestigt sind.

Revendications

1. Serre-joints à genouillère à actionnement linéaire/ à entraînement rotatif comprenant :
   une base (11),
   un moteur réversible (36),
   un arbre d'entraînement (38),
   un écrou fileté (30),
   une tige filetée (29),
   une bielle de genouillère (23),
   un élément de serrage (12),
   une connexion de déplacement à entraînement rotatif et linéaire entre ledit écrou (30) et la tige (29), actionnée par l'arbre d'entraînement (38) du moteur rotatif aligné axialement,
   et un moyen (33) pour résister à une poussée axiale, pour l'un (30) desdits éléments: écrou (30) et tige (29), et un moyen d'entraînement en déplacement axial pour l'autre (29) de ces éléments, ledit autre élément étant pourvu d'une connexion (25) d'entraînement axial, sans rotation, avec ladite bielle de genouillère,
   ladite bielle de genouillère étant pourvue d'une connexion d'actionnement (24, 22) avec ledit élément de serrage (12),
   une connexion (39) d'entraînement rotatif direct entre ledit arbre d'entraînement (38) et ledit écrou fileté (30),
   ledit arbre d'entraînement (38) présentant un alésage axial (69) pour recevoir ladite tige filetée (29) lors de la rotation réactive dudit écrou fileté (30),
   caractérisé en ce que ladite tige filetée (29) est pourvue d'une connexion à guidage linéaire (26, 27) avec un élément de guidage (14, 28) à réaction latérale,
   on ce qu'un passage (70) de tige de commande s'étend depuis ledit alésage (69) jusqu'à l'extrémité dudit arbre d'entraînement (38),
   et ce qu'une tige de commande (40) s'étend depuis l'extrémité de ladite tige filetée (29) à travers ledit passage (70) de tige jusqu'à une position externe d'actionnement de commutateur.

2. Serre-joints selon la revendication 1, incluant un palier de poussée anti-friction (33) pour effectuer le maintien axial dudit écrou fileté.

3. Serre-joints selon la revendication 1 ou 2, dans lequel l'écrou (74) a un filetage en plastique moulé.

4. Serre-joints selon la revendication 3, dans lequel ledit filetage en plastique (74) comprend du disulfure de molybdène.

5. Serre-joints selon la revendication 4 dans lequel le filetage en plastique (74) présente une forme à fond de filet incurvé (77).

6. Serre-joints selon la revendication 5, dans lequel ledit fond incurvé s'étend jusqu'à être tangent à des flancs latéraux angulaires (77).

7. Serre-joints selon la revendication 6, dans lequel lesdits flancs latéraux se terminent par des plats s'étendent axialement (Fig. 13).

8. Serre-joints selon l'une quelconque des revendications précédentes, incluant un prolongement (25, 25a) de l'actionneur de bielle de la tige filetée.

9. Serre-joints selon l'une quelconque des revendications précédentes dans lequel ledit élé-

ment de guidage (14, 28) à réaction latérale comprend une piste de guidage (28).

10. Serre-joints selon la revendication 9, dans lequel ledit prolongement est pourvu de galets anti-friction (27) venant en contact dans une paire d'éléments opposés de la piste (28).

11. Serre-joints selon la revendication 10, dans lequel ladite base comprend un corps de forme générale rectangulaire (10), ledit corps étant pourvu de moyens (50 à 53) pour s'adapter à un montage sur l'une quelconque de quatre faces rectangulaires adjacentes perpendiculaires entre elles, d'un alésage (34) pour le logement desdits paliers de poussée, d'un passage axial (48) pour ladite tige filetée, et de moyens (15, 16, 17) de montage de ladite paire d'éléments de piste.

12. Serre-joints selon la revendication 11, dans lequel chacun desdits éléments de piste présente un évidement formant piste linéaire (28), prévu pour qu'un galet anti-friction (21) vienne en contact sur lui, se terminant dans une extrémité semi-circulaire prévue pour un contact d'arrêt dudit galet à la position de serrage de ladite liaison à genouillère, et un prolongement (25) de tige filetée, sur lequel sont montés une paire de galets anti-friction (27) venant en contact avec lesdits évidements linéaires formant piste (28).

13. Serre-joints selon l'une quelconque des revendications précédentes dans lequel ledit arbre d'entraînement du moteur présente un diamètre étagé avec un extérieur cannelé (66), un contre-alésage (69) à l'intérieur, un passage traversant (70) de tige de commande et une extrémité d'entraînement pourvue d'ergots.

14. Serre-joints selon l'une des revendications 12 ou 13 dans lequel ladite tige filetée porte un prolongement (25a), d'un seul tenant, d'actionnement de bielle et une extrémité, dans laquelle est ménagée une ouverture, apte à loger une broche disposée en croix (26) pour le montage de galets anti-friction (21) venant au contact de la piste.

15. Serre-joints selon la revendication 10 dans lequel ladite base inclut un prolongement d'un seul tenant situé entre ladite paire d'éléments de piste en vue d'une connexion maintenant l'espacement de ceux-ci, et une paire de prolongements latéraux extérieurs (19) situés latéralement à l'extérieur desdits éléments de piste.

16. Serre-joints selon la revendication 15 incluant, en vue d'une attache sur lesdits prolongements latéraux, un élément d'arrêt à clavette (18) pourvu de moyens d'espacement desdits éléments de piste tant dans les directions antérieure et postérieure que latérales afin d'inclure un espace de jeu permettant de monter à pivotement entre eux le bras de serre-joints.

17. Serre-joints selon l'une quelconque des revendications précédentes dans lequel ledit élément de guidage à réaction latérale comprend un moyen anti-friction fixé sur ladite base venant en contact avec ledit autre élément.

FIG.1

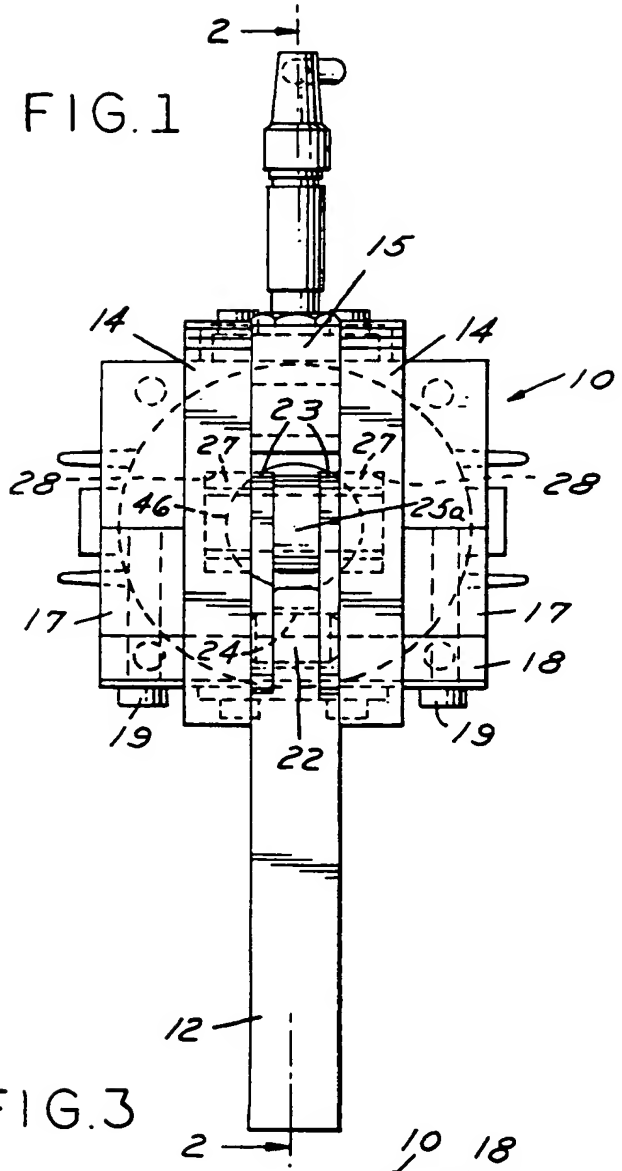
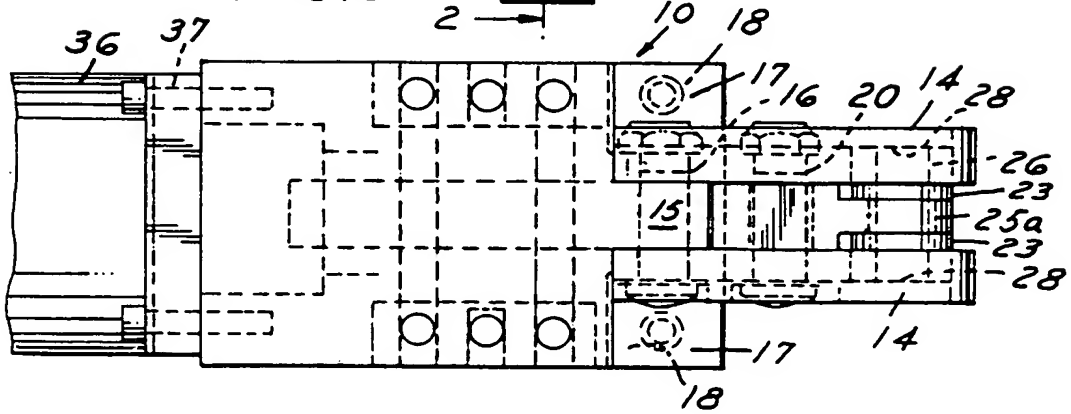

2
15
14
14
10
23
27
27
28
28
46
25a
17
17
24
18
19
19
22
12

FIG.3


2
10
18
36
37
17
16
20
14
28
26
23
15
25a
23
28
14
17
18

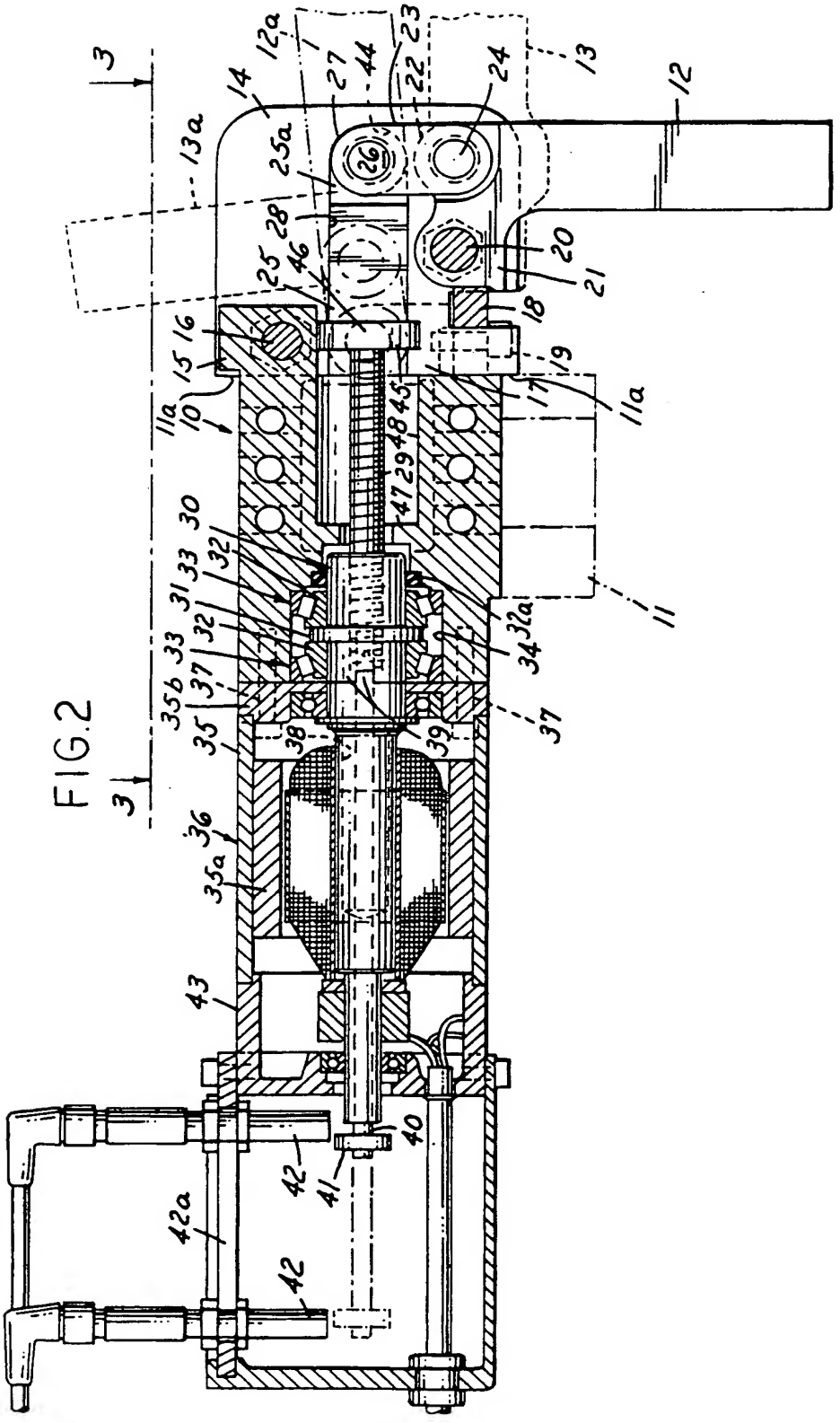

3
12a
23
27
44
22
24
13
12
14
13a
25a
26
28
25
46
20
21
18
16
15
19
10
11a
45
48
29
47
30
33
32
31
32a
34
37
35a
35
38
39
36
43
40
42
41
42a

FIG.2

FIG.4

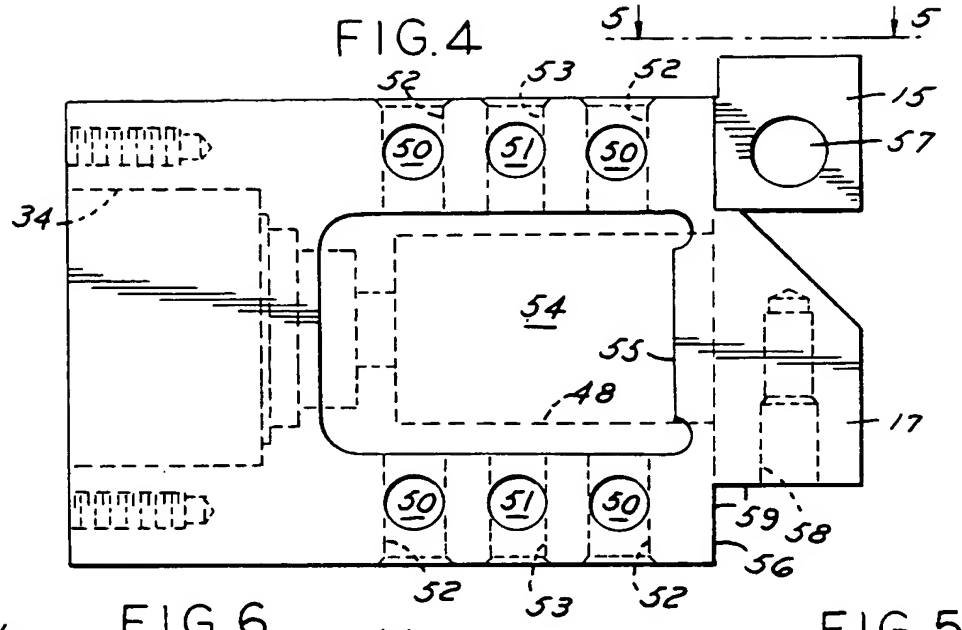


FIG.6

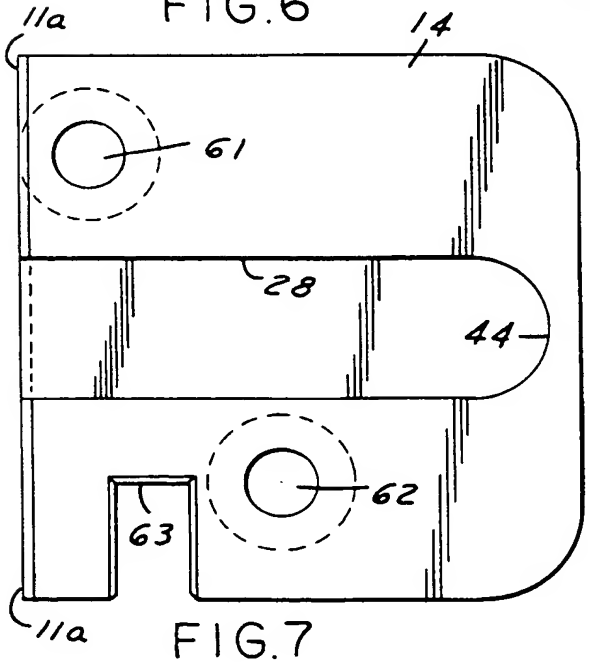


FIG.5

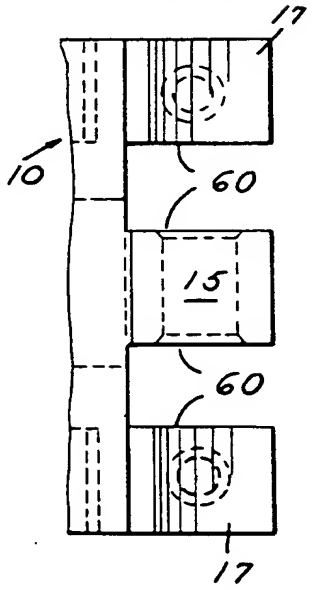


FIG.7

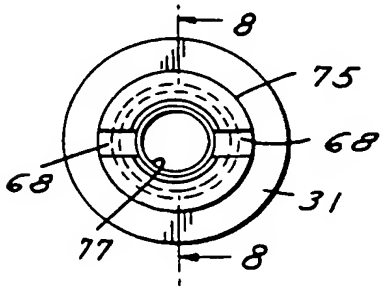


FIG.8

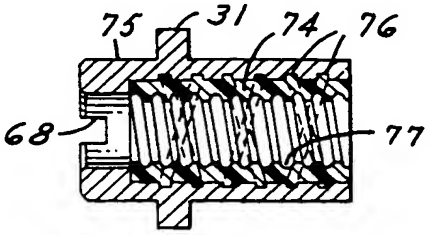


FIG.10

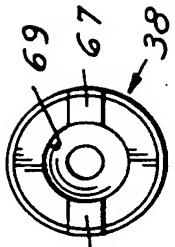


FIG.9

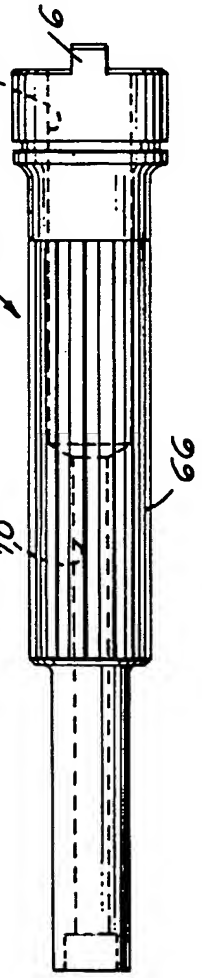


FIG.11

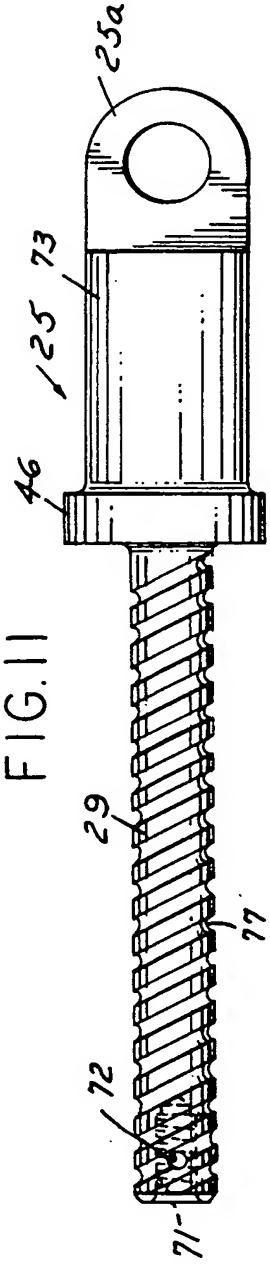


FIG.12

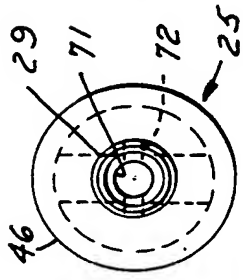


FIG.14

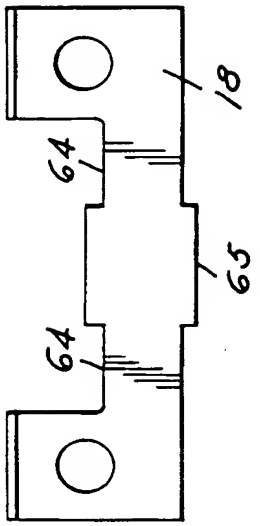


FIG.13